ABSTRACT

The scarcity of natural materials along with the environmental constraints and prohibition of mining and quarrying demands the exploration of secondary materials as substitutes. Efforts are in progress worldwide to explore the possible use of construction and demolition (C&D) waste for a wide range of applications. The present study assesses the feasibility of using C&D waste for geotechnical applications e.g., structural fill for constructing mechanically stabilized earth (MSE) walls or as an earthfill. The study assessed the following:

i. Feasibility of using processed C&D waste termed sand-sized mixed recycled aggregate (SS_MRA) as structural fill for MSE walls
ii. Feasibility of using unprocessed C&D waste as backfill for embankments.

The first part of the thesis experimentally evaluates the suitability of SS_MRA as structural fill in MSE walls in lieu of conventional fill material (CFM). Detailed physicochemical, geoenvironmental and geotechnical characterization of SS_MRA are carried out, and results are compared with locally available Badarpur sand (BS) and Yamuna sand (YS) (natural reference materials/CFM). The geoenvironmental characterization of SS_MRA shows that heavy metals and total soluble solids are more than the reference materials but are within limits for inert waste and the values reported in the literature. Experimentally determined gradation, physical and shear strength characteristics, and electrochemical properties of SS_MRA met the standard specifications for the structural fill of different guidelines/codes of practice. Pullout tests were conducted to evaluate the soil-geosynthetic peak interface apparent coefficient of friction ($\mu_{S/GSY}$) between geosynthetic reinforcement (geogrids (GG-80 and GG-350) and polymeric strips (PS-25 and PS-50)) and selected structural fill (SS_MRA). The influence of poor compaction on geosynthetic reinforcement – SS_MRA interactions are evaluated, and the results are compared with those of geosynthetic

reinforcement in natural reference materials. Poor compaction significantly lowers $\mu_{S/GSY}$ particularly in polymeric strips. $\mu_{S/GSY}$ of geosynthetic reinforcement embedded in MRA is comparable with the reference materials and the values reported in the literature.

The second part examines the suitability of using (-4.75 mm) unprocessed C&D waste in earthfill applications. The detailed physicochemical, geoenvironmental and geotechnical characterization was carried out, and the results are compared with the local available soil (Delhi silt (DS)). The geoenvironmental characterization reveals that (-4.75 mm) unprocessed C&D waste has elevated heavy metals and total soluble solids compared to local soil but is within limits for inert waste criteria. From the geotechnical characterization, it can be concluded that (-4.75 mm) unprocessed C&D waste has properties similar to local soil and, thus, can be used in earthfills.

In addition, geoenvironmental characterization of fines obtained during processing C&D waste, termed recycled aggregate sludge (RA_S), has been carried out. The experimental results reveal that RA_S has a very high total soluble solids concentration and is within limits for non-hazardous waste. Thus, it is unsuitable for reusing without prior treatment.

Thus, the results of the present study encourage the construction industry in bulk utilization of SS_MRA as structural fill in MSE walls and (-4.75 mm) unprocessed C&D waste for earthfills.